Phase III – Remedial Action Plan (RAP) Report

Draper Landfill Site
161 Freedom Street
Hopedale, Massachusetts

RTN: 2-0000765

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Prepared for:

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Section 1
Introduction

Camp Dresser & McKee Inc. (CDM), on behalf of Rockwell Automation, Inc. (Rockwell) has prepared this Phase III – Remedial Action Plan (RAP) for the Draper Landfill Site (Site). The RAP includes identification, evaluation and selection of comprehensive remedial action alternatives in accordance with 310 CMR 40.0850 of the Massachusetts Contingency Plan (MCP).

The Massachusetts Department of Environmental Protection (MassDEP) issued Rockwell a Notice of Responsibility (NOR) – Request for Release Notification dated March 22, 2006, as the former owner of the Draper Landfill property located in Hopedale, Massachusetts. MassDEP determined that the property contained a disposal site based on review of a United States Environmental Protection Agency (EPA) sponsored investigation report. MassDEP subsequently assigned Release Tracking Number (RTN) 2-0016139 to the site on March 6, 2006, based on the presence of hazardous materials in excess of 120-day reporting concentrations (RCs) in soil and groundwater. As a result, CDM completed Substantial Release Migration (SRM) and Immediate Response Action (IRA) site investigations to further define the nature and extent of contamination.

The IRA Status Report documenting the results of the IRA site investigation concluded that no significant risk to human health associated with landfill releases to the adjacent stream existed and no immediate response actions to address potential hazards were required. The report further concluded that additional site investigation activities were necessary in the form of a Phase I Initial Site Investigation. The Phase I Investigation, which focused on the landfill portion of the property, included the following components:

- A review of prior reports, including the January 2006 Non-Superfund Targeted Brownfields Assessment Final Report by Metcalf & Eddy, Inc. which includes an Environmental Data Resources, Inc. (EDR) file search of historical and regulatory information on documented releases or threats of release of oil and/or hazardous materials;

- Field investigations, including a topographic and boundary survey, soil gas sampling, test pitting, soil boring and monitoring well installations, soil and groundwater sampling and laboratory analyses. Development of investigation findings into a Phase I – Initial Site Investigation Report in accordance with 310 CMR 40.0480;

- A numerical ranking of the site and preparation of a Numerical Ranking System (NRS) Scoresheet;

- Tier classification of the site and preparation of the Tier Classification Submittal Transmittal Form (BWSC-107); and

- Preparation of a Phase II Scope of work.

The Phase I Report, submitted to the MassDEP on March 5, 2007, included the following documents:

- Phase I – Initial Site Investigation Report;
- Numerical Ranking System Score Sheet;
- Tier Classification Submittal Transmittal Form (BWSC-107);
- Comprehensive Response Action Transmittal Form & Phase I Completion Statement (BWSC-108); and
- Phase II Scope of Work.

The Phase I submittal concluded that the site is classified as Tier IA based on groundwater contamination, including trichloroethene (TCE) and vinyl chloride (VC), at concentrations above RCGW-1 Reportable Concentrations in a Zone II area and a Disposal Site Score of 626. The site was assigned Tier IA Permit Number W122411. The Phase I investigation indicated that further comprehensive response actions were necessary at the site beginning with a Phase II Comprehensive Site Assessment (CSA).

A Phase II CSA has been completed for the site, which included the following components:

- Preliminary site visits to identify monitoring well and sampling locations and obtain site information from local residents and Town employees;
- Soil gas field screening of the northeast portion of the landfill where elevated soil gas reading were detected during the Phase I investigation;
- Completion of soil borings and installation of four overburden and four bedrock monitoring wells, collection of soil boring samples and analyses for contaminants of concern (COC) including volatile organic compounds (VOC), semivolatile organic compounds (SVOC), polychlorinated biphenyls (PCB)/pesticides, metals, cyanide, and petroleum compounds;
- Groundwater sampling and analyses for COC from all site overburden and bedrock monitoring wells;
- Surface water and sediment sampling and analyses for COC from the stream on the west side of the site; and
- Preparation of the Phase II CSA report including human health and environmental risk characterizations.

The Phase II CSA findings provide the basis for the Phase III RAP and both reports are being submitted concurrently.

1.1 Purpose and Scope

According to 310 CMR 40.0853 of the MCP, a Phase III evaluation shall result in:

1. The identification and evaluation of remedial action alternatives which are reasonably likely to achieve a level of No Significant Risk considering the oil and hazardous material present, media contaminated, and site characteristics;

2. The recommendation of a remedial action alternative that is a Permanent or Temporary Solution, where a Permanent Solution includes measures that reduce, to the extent feasible, the concentrations of oil and hazardous material in the environment to levels that achieve or approach background; and

3. A Phase III Remedial Action Plan (RAP) that describes and documents the information, reasoning and results used to identify and evaluate remedial action alternatives in sufficient detail to support the selection of the proposed remedial action alternative.

1.2 Scope of Work

According to 310 CMR 40.0855 and 310 CMR 40.0858 of the MCP, the identification and evaluation of remedial action alternatives shall include:

1. An initial screening to identify those remedial action alternatives that are reasonably likely to be feasible and achieve a level of No Significant Risk;

2. A detailed evaluation of the remedial action alternatives identified by the initial screening to ascertain which alternatives will achieve a Permanent or Temporary Solution under 310 CMR 40.0850, 40.0900 and 40.1000; and

3. A discussion of the comparative effectiveness, short-term and long-term reliability of the alternatives, the difficulty in implementing each alternative, and the risks, costs, benefits, and timeliness of each alternative.

The following Phase III Remedial Action Plan has been prepared in accordance with the requirements of 310 CMR 40.0850. According to the MCP, a RAP shall contain:

1. A description of all remedial action alternatives initially defined and the results of the initial screening;

2. Where a detailed evaluation is required, a discussion of how the alternatives remaining after the initial screening compare with respect to the criteria described in 310 CMR 40.0858;

3. Justification for the selection of the proposed remedial action alternative;

4. Where required, the results of the evaluation under 310 CMR 40.0860 of whether the implementation of a Permanent or Temporary Solution is feasible;

5. If a Permanent Solution is selected as the remedial action alternative, a discussion of how the alternative is likely to achieve a level of No Significant Risk;

6. If a Temporary Solution is selected as the remedial action alternative, a discussion of how the alternative is likely to eliminate any substantial hazards posed by the disposal site until a Permanent Solution is implemented;

7. If a Permanent Solution is selected, the results of the evaluation under 310 CMR 40.0860 of the feasibility of reducing the concentrations of oil and hazardous material in the environment at the disposal site to levels that achieve or approach background, unless the RAP otherwise includes a demonstration that the selected alternative is designed to achieve background and a Class A-1 Response Action Outcome;

8. If the selected remedial action alternative is a Temporary Solution, a detailed description of definitive and enterprising steps pursuant to 310 CMR 40.0580 to identify and develop an alternative that is a likely Permanent Solution and a schedule for the implementation of such steps, which may include: performing pilot tests or bench-scale studies; investigating innovative ways to reduce the costs or the risks of implementing a specific alternative; and developing new technologies; and

9. A projected schedule for implementation of Phase IV activities pursuant to 310 CMR 40.0870.

1.3 Overview of Remedial Action Plan

The RAP is organized as follows:

- Section 1 is an introduction that provides background information; a discussion of the purpose and scope of the RAP; scope of work and overview of the Phase III report.

- Section 2 provides a site description including surrounding land use, and a summary of the Phase II CSA, which describes the nature and extent of contamination and risk assessment conclusions.

- Section 3 presents the remedial action objectives; contaminant migration and exposure pathways and impacted media; and the initial screening of likely remedial action alternatives applicable to the impacted media at the site.

- Section 4 provides a detailed evaluation of the remedial action alternatives for each impacted media retained from the initial screening including a discussion of the evaluation process and criteria.

- Section 5 presents the selection of the remedial action alternative, feasibility evaluations and the anticipated project schedule for implementation of Phase IV activities.

Section 2 Site Information

2.1 Site Description

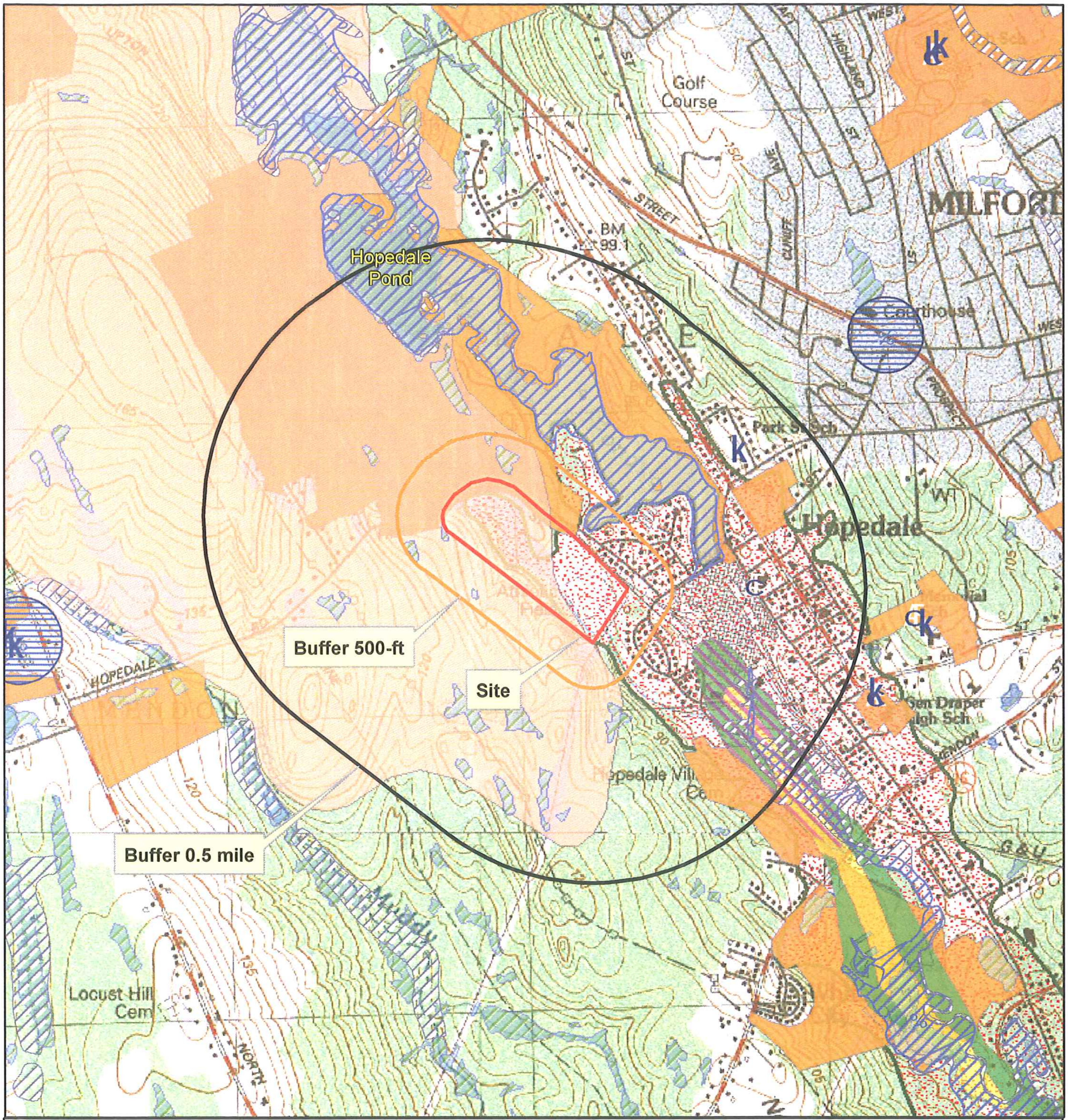
The Draper Landfill site is located at 161 Freedom Street in Hopedale, Massachusetts. A MassGIS map showing the site location and local areas of environmental concern is provided on **Figure 2-1**. Hopedale Tax Assessor's Map Nos. 8 and 9 show the 42-acre property as Lot No. 5. The site is located at North latitude 42.1337 and West longitude 71.5491 with Universal Transverse Mercator (UTM) coordinates N: 4667933 and E: 288987. The site includes an inactive landfill on the northern portion of the property and baseball fields on the southern portion of the property. The landfill area, which occupies approximately eight acres, is the focus of the MCP response actions at the site.

The site is located within a MassDEP approved Zone II area (i.e. area of an aquifer which can be realistically anticipated to contribute water to a public water supply well under the most severe pumping and recharge conditions) and therefore the MCP groundwater reporting category is RCGW-1. Drinking water standards also apply within a Zone II area. The majority of the Town of Hopedale is provided with public water supplied from two well fields located on Green Street and Mill Street approximately one mile and two miles southeast of the landfill, respectively

There are no records of installation of a liner under the landfill or a typical MassDEP solid waste landfill cap over this portion of the site. Landfill refuse and debris, including tires, metal and wood are exposed on the west side of the landfill.

The baseball field portion of the site include backstops, groomed fields, fencing, bleachers, dugouts and benches and an entrance road and paved parking area to the south. A second gated access road is located northeast of the baseball fields.

Stormwater drainage north of the property along Freedom Street is collected by a system of catch basins and conveyed by a concrete pipe system. A drain box provides a junction for three concrete drainage pipes immediately north of the landfill and transfers this stormwater flow through a concrete drainage pipe that runs approximately 25 feet beneath the landfill surface and discharges to an unnamed stream on the west side of the landfill. The stream bed from the culvert discharge and several hundred feet downstream is colored orange, which is considered to be the result of iron precipitation associated with the landfill. The stream flow increases by about 50% approximately 500 feet downstream as a result of the contribution from another stream intersecting from west of the landfill. The unnamed stream continues south, past the baseball fields and exits the site through an underground culvert that discharges to a continuation of the stream behind the Bancroft Park residential area, eventually discharging to the Mill River.



Legend

- Protected Open Space
- High Yield Aquifer
- Medium Yield Aquifer
- Sole Source Aquifer
- Zone A
- Zone II
- Non-potential Drinking Water Supply Area
- Interim Wellhead Protection Area (IWPA)
- DEP Wetlands
- Areas of Critical Environmental Concern
- NHESP 2003 Priority Habitats for State-Protected Rare Species
- % Public Water Supply (Wells)
- NHESP 2003 Mass. Certified Vernal Pools
- P Hospital
- i Nursing Home
- k School
- ñ College
- C Library
- m Prison

FEMA Q3 Flood

- Zone AE
- Zone X

Figure 2-1
Phase III - Remedial Action Plan
161 Freedom Street
Hopedale, Massachusetts

N

0 750 1,500 Feet

Source: MassGIS Datalayers
Basemap: USGS 7.5 Minute Topographic Quad Sheet
Datum: NAD 83
Coordinate Sys: Mass State Plane Mainland
Units: meters

CDM

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Access to the site by pedestrians is unrestricted. Vehicle access is partially restricted at the two property entrances by gates and the southern entrance to the landfill area is blocked by a telephone pole on the ground surface.

2.2 Surrounding Land Use

The Draper landfill property is bordered by Freedom Street and woodlands to the north; residences in the Bancroft Park neighborhood to the south; Freedom Street, woodlands, and residences to the east; and woodlands and residences on Whitney Road and Westcott Road to the west. The area immediately north and east across Freedom Street from the landfill is a wooded parkland with trails, characterized by bedrock outcrops and elevated topography. The closest residences to the west of the landfill are approximately 500 feet away at higher elevations characteristic of this area. Residential areas are also located south, east and west of the ballfields' portion of the property. The inactive Draper Mill complex is located approximately 1,000 feet southeast of the site near the center of Hopedale. The Mill River drains from Hopedale Pond and runs through the Draper Mill complex to the south. The Hopedale Village Cemetery is located approximately 1,500 feet to the southwest of the site.

2.3 Phase II CSA Summary and Conclusions

Site investigations completed to-date including the Phase I Initial Site Investigation and Phase II CSA Investigation for the Draper Landfill site resulted in the following findings and conclusions:

- The Draper Landfill area of the site received industrial, municipal and construction waste for a period of time estimated at over 30 years and ending in the 1970's. The area of waste disposal is estimated at approximately 8 acres with waste depths of up to 25 feet.

- The site was initially classified by MassDEP as a disposal site and assigned RTN 2-0765 in 1990 following a MassDEP investigation of the adjacent stream. The site is currently classified under RTN 2-0000765 as a Tier ID site and has also been assigned RTNs 2-0016288 and 2-0016139 based on the SRM condition and review of the M&E TBA report, respectively. The M&E TBA investigation included surface water and sediment sampling, the installation of five soil borings construction of four monitoring wells, and soil and groundwater sampling and analyses. CDM subsequently completed SRM and IRA investigations that included surface water, sediment, leachate and groundwater sampling and analyses. The investigations indicated the presence of contamination above GW-1 standards and the migration of landfill-related contamination to the adjacent stream.

- The 2006 SRM and IRA analytical data indicated that releases from the landfill to groundwater were detected in the adjacent stream, with DCE and TCE concentrations providing the strongest link to the landfill. Although the investigation results indicated some impact from the landfill to the adjacent stream, the human health risk evaluation of the stream surface water and sediments concluded that No Significant Risk exists at the stream with regard to human health. The surface water and sediment data collected in the Phase II investigation indicated similar levels of contamination associated with the landfill's impact on the stream.

- The site is categorically classified as Tier I based on the Tier I Inclusionary Requirement for a disposal site with groundwater contamination at concentrations exceeding the RCGW-1 Reportable Concentrations. A Tier Classification was completed (and submitted with the Phase I Initial Site Investigation Report) for the site indicating a Tier 1A classification based on the Disposal Site Score of 711.

- A Phase I site investigation was conducted from December 2006 through February 2007, which included the field screening of 22 soil gas sampling locations for typical landfill gases and VOCs; installation of nine soil borings that were completed as monitoring wells; excavation of 12 shallow test pits on the landfill surface to investigate landfill cover material and 4 test trenches on the southern landfill boundary to investigate the limit of waste disposal; and completion of topographic and property boundary survey. Soil and groundwater samples were collected and analyzed for VOCs, SVOCs, metals, pesticides and PCBs.

- The test pit investigation of the landfill surface indicated the landfill waste material is covered by a silty sand layer ranging in thickness from several inches to two feet. The cover soil does not meet the requirements for a MassDEP solid waste cap nor does it isolate the landfill waste from infiltration of precipitation.

- Phase I soil gas screening of the landfill, which included the installation and field screening of 22 soil gas probes, indicated the presence of typical landfill gases including hydrogen sulfide, methane and carbon dioxide. Elevated levels of VOCs were also detected at several sample locations, primarily in the northeast area of the landfill where industrial waste disposal was reported. The Phase II landfill gas investigation included the installation and field screening of 11 additional soil gas probes and collection and lab analyses of five soil gas samples. The investigation focused on the northeast portion of the landfill where elevated VOCs were detected during the Phase I screening activities. The Phase II soil gas investigation indicated the presence of a number of VOCs which supported the reported disposal of industrial wastes in this area. Field screening of ambient air during the Phase I and II investigation activities did not indicate significant concentrations of landfill gases.

- Soil samples were collected from four test pits excavated on the southern boundary of the landfill and analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), pesticides and metals. The test pit soil results generally indicated concentrations below method detection limits (MDLs) and all below MCP Method 1 S-2 standards for all parameters except for one test pit where total chromium and lead were reported above their respective S-2 standards.

- Soil samples were collected from nine Phase I investigation soil borings at depths suspected of contamination based on field screening and/or observation and analyzed for VOCs, SVOCs, PCBs, pesticides and metals. No PCBs or pesticides were detected above MDL in any soil boring soil sample. Naphthalene was detected during VOC analyses above S-2 standards at soil borings MW4 and MW5. Several SVOCs were also detected above their respective S-2 standards at MW4 and MW5 and one was also detected above the S-2 standard at MW8. One metal was detected above the S-2 standard at soil boring location MW5. Soil samples were also collected from five of nine additional soil borings installed during the Phase II investigation. Samples were collected in the same manner and analyzed for the same parameters (with the addition of MassDEP EPH and VPH) as Phase I. The results indicated concentration for PCBs and pesticides; VOCs and VPH; and SVOCs below S-2 standards. Exceedences of S-2 standards were reported for a few EPH parameters at two locations and for lead at two locations. These exceedences appear to be related to fill materials rather than the landfill.

- The groundwater data from the Phase I investigation January 2007 sampling event at the four existing monitoring wells and seven new monitoring wells continued to indicated the presence of VOCs including trichloroethene (TCE) and its breakdown products, cis and trans-1, 2-dichloroethene (cis-DCE & trans-DCE) and vinyl chloride (VC) at well locations immediately downgradient of the southern edge of the landfill. Several of the VOCs reported for groundwater samples from these wells were slightly above the GW-1 standards. Several metals including arsenic and barium and SVOCs were detected above GW-1 standards, however the pattern of detections indicates the source of these elevated parameters as fill material rather than the landfill. The monitoring wells on the north side of the landfill indicated minor impacts from the landfill and the groundwater table below the bedrock surface in some locations.

- The groundwater data from the Phase II investigation included three rounds of sampling from a total of 21 monitoring wells including the four M&E TBA investigation monitoring wells; seven Phase I investigation monitoring wells; and nine new Phase II investigation monitoring wells (including four bedrock wells and five overburden wells). The groundwater sampling results continued to indicated the presence of VOCs including trichloroethene (TCE) and its breakdown products, cis and trans-1, 2-dichloroethene (cis-DCE & trans-DCE) and vinyl chloride (VC) at well locations immediately downgradient of the southern edge of the landfill. Several of the VOCs reported for groundwater samples from these wells were above the GW-1 standards. The groundwater data pattern includes consistent VOC levels above the GW-1 criteria over several rounds of monitoring at wells B5-MW and CDM-MW7 immediately downgradient of the southern edge of the landfill. The VOC detections decrease in concentration and frequency approximately 400 feet further downgradient at the next set of monitoring wells. VOC concentrations decrease to below method detection limits at the final set of wells approximately 400 feet further downgradient at the southern edge of the baseball field area. Several metals (including arsenic and barium) as well as SVOCs were detected above GW-1 standards in wells in the baseball field area; however the pattern of detections indicates the source of these elevated parameters as soil fill material rather than the landfill. The two bedrock wells located on the north side of the landfill, including well CDM-BR2A installed between the landfill and the residential water supply well located west of the landfill on Freedom Street, consistently indicated most parameters below method detection limits and all parameters below GW-1 standards. The one bedrock well (CDM-BR3) located immediately downgradient of the southern edge of the landfill indicated slight exceedences of GW-1 standards for TCE and VC.

- Groundwater elevations recorded at the site through the Phase I and Phase II investigations support an understanding that the general groundwater flow direction is to the south/southeast.

- The Stage I Environmental Screening indicated that several complete and significant exposure pathways exist. Specifically, the presence of several chemicals in surface soil, including those that are bioaccumulative, in addition to the accessibility of waste along western edge of the landfill slope indicate that surface soil exposure likely represents a potentially significant pathway. The complete exposure pathways associated with sediment and surface water described in Section 10.5 also represent potentially significant pathways. The presence of one or more chemicals in surface water at concentrations above the NRWQC (EPA, 2006) in the stream at this site represent "readily apparent harm" as defined in the MCP regulations under 310 CMR 40.0995(3)(b)1.b. This is further supported by the conclusion that the landfill caused an SRM at the site, specifically, the release of hazardous material to surface water. Additionally, the presence of the iron staining in wetland sediments in conjunction with elevated chemical concentrations may also meet this definition for this medium. In accordance with the MCP regulations, a finding of "readily apparent harm" precludes the need to conduct a Stage II ERC for these media, since it has already been determined that a condition of "no significant risk of harm" does not exist at this site and remedial action is warranted.

- The human health risk characterization concluded that a condition of NSR to human health has been achieved for current/future child trespassers exposed to contaminants in surface water, sediment and landfill gas, as the cumulative estimated cancer risk was below the MCP acceptable risk and hazard limits. A condition of NSR also exists for current/future construction workers exposed to soil at the southern edge of the landfill. A condition of NSR has not been achieved for future residents that may come into contact with groundwater via potable use, as the cumulative cancer and noncancer risks for the majority of the wells exceed risk and hazard limits. Additionally, drinking water standards and guidelines were exceeded for many chemicals. These results indicate that additional remedial efforts are necessary.

- The Phase II Site Investigation activities documented in the Phase II CSA Report indicate that additional comprehensive response actions are necessary at the site, including a Phase III Feasibility Study for the Identification, Evaluation and Selection of Comprehensive Remedial Action Alternatives as described 310 CMR 40.0850 to select a remedial action alternative.

Section 3 Identification and Initial Screening of Remedial Action Alternatives

This section provides the initial screening of the identified remedial action alternatives that are reasonably likely to be feasible based on the oil and hazardous material present, media impacted and site specific characteristics. The feasibility evaluation considers whether:

1. The technologies to be employed are reasonably likely to achieve a Permanent or Temporary Solution and achieve a level of No Significant Risk; and

2. Individuals with the necessary expertise to effectively implement the solution are available.

3.1 Remedial Action Objectives

The objective of the Phase III evaluation is selection of a remedial action alternative which is likely to achieve a Permanent Solution. The MCP defines a Permanent Solution as a measure, or combination of measures which will attain a level of control of each identified substance of concern at the disposal site to achieve a level of no significant risk of damage to health, safety public welfare or the environment during any foreseeable period of time. The remedial action objectives for each impacted medium are based on the potential for human and environmental exposure and associated risks posed by the hazardous material present in the waste buried in the Draper landfill. The risk assessment performed for the Draper Landfill site in the Phase II CSA concluded that a condition of No Significant Risk to human health has not been achieved at the site for all unrestricted uses and/or activities. The risk was based primarily on the presence of groundwater contaminants, including VOCs and metals above GW-1 standards. The Phase II CSA environmental risk assessment also determined that a condition of No Significant Risk to the environment has not been achieved.

The remedial action objectives consider:

- Site characteristics that delineate the fate and transport of site-related contaminants;

- Human and environmental receptors; and

- Impacted media and potential routes of exposure to site-related contaminants.

The primary site characteristics which determine the feasibility of remedial action alternatives at the Draper Landfill are the size and heterogeneity of the waste material present in the landfill. Remedial technologies which involve excavation and treatment or disposal of the contaminated waste material are not considered feasible. The remediation strategy, which is typical for landfills, focuses on capping and containment of the waste material and control of the potential contaminant migration pathways.

3.2 Contaminant Migration and Exposure Pathways/Impacted Media

The primary media of concern at the Draper Landfill site is the waste material within the landfill, which is the source of site contamination. Exposure to contamination associated with the buried waste material is possible through a number of release/transport mechanisms including the following:

- Direct contact
- Leachate generation
- Landfill gas release
- Erosion by wind and stormwater runoff

The primary potential contaminant release mechanism is the generation of leachate by precipitation infiltrating the landfill surface and mixing with the landfill waste materials. The Draper Landfill does not have a low permeability cap, surface drainage system or a landfill liner to control the generation and movement of leachate. Leachate typically carries suspended and dissolved contaminants to groundwater beneath a landfill and also to adjacent surface water and sediment through seeps on the landfill sideslopes.

The decomposition of organic waste materials present in a landfill results in the generation of landfill gases. Landfill gas generation rates and composition depend on a number of factors including waste nature and quantity, disposal practices, age, depth, moisture and oxygen content. Typical landfill gases include carbon dioxide, methane, nitrogen and hydrogen sulfide, VOCs may also be present depending on the nature of wastes disposed of at the landfill. Landfill gas monitoring conducted during the Phase I and II site investigations has indicated the generation of landfill gas including VOCs, primarily along the eastern edge of the landfill.

Evidence of significant contaminant releases to the environment due to erosion by wind and stormwater runoff has not been observed. Stormwater runoff contact with leachate seeps may have contributed to localized impacts to wetland areas on the west side of the landfill. Waste materials are exposed and leachate seeps have been observed on this side of the landfill.

Media impacted by the landfill contamination include groundwater, soil, surface water and sediments. Landfill related contamination, including primarily VOCs and metals, has been consistently detected above GW-1 standards in groundwater in monitoring wells immediately downgradient from the southern edge of the landfill. Subsurface soil contamination, including SVOCs and metals above S-2 standards were detected at some soil boring and test pit locations. Although the landfill may have contributed to some of the elevated concentrations immediately adjacent to the landfill, the primary source of these elevated concentrations in the ballfield area is likely associated with fill material (including ash material) used in the construction of this area. Evidence of ash material was observed in test pit and soil boring samples from the landfill and ballfield areas. Surface water sample results, including VOCs and metals, as well as iron floc indicate impacts to the stream on the west side of the landfill. Similarly, sediment sample results for the same contaminants, in the stream on the west side of the landfill, show evidence of landfill related contamination.

The initial screening of remedial action alternatives for each of the impacted media is presented below.

3.3 Initial Screening of Likely Remedial Action Alternatives

In accordance with 310 CMR 40.0856, remedial action alternatives were identified which were considered likely to be feasible, based on the oil and hazardous materials detected at the Draper landfill, the impacted media and site characteristics. The remedial action alternatives identified for screening for the Draper Landfill focused on technologies applicable to containment of the landfill waste materials and remediation of the media identified as impacted in the Phase II CSA.

3.3.1 Landfill Waste Material

Containment of the landfill waste by capping is the most practicable remedy for the landfill. Capping of municipal landfills is required by MassDEP solid waste regulations and accepted by the United States Environmental Protection Agency (EPA) as the "presumptive remedy" for CERCLA municipal landfill sites.

Containment by capping is appropriate for municipal landfill waste because the large volume and heterogeneity of the waste generally make treatment alternatives impracticable. Components of the presumptive remedy for municipal landfills may include some or all of the following, as appropriate, based on site specific conditions: landfill cap; collection and/or treatment of landfill gas; and/or, control of landfill leachate, affected groundwater at the landfill perimeter, and/or upgradient groundwater that is causing saturation of the landfill mass.

Capping of the landfill will contribute to a permanent solution by containing the source of contamination at the site and mitigating migration of contamination off-site by controlling landfill gas emissions, minimizing leachate generation and associated groundwater, soil, surface water, and sediment impacts. Capping addresses the following landfill related contaminant migration pathways:

- Preventing direct contact with landfill waste materials;
- Reducing leaching of contaminants to the groundwater;
- Controlling surface water runoff and erosion;

- Controlling landfill gas migration and emissions; and
- Mitigating impacts to adjacent stream surface water and sediment.

Personnel with expertise in landfill cap design and construction are readily available. Landfill capping is considered feasible and therefore will be retained for detailed evaluation.

Remedial technologies involving treatment and source removal were not considered reasonably likely to be feasible for the landfill waste materials because of the large volume and heterogeneity of the landfill waste material. Isolated "hotspots" of contamination at the landfill suitable for treatment or removal were not identified during the Phase II investigation.

3.3.2 Groundwater

The landfill related contamination detected in the groundwater immediately downgradient from the landfill primarily included TCE and its breakdown products, 1,2-DCE and VC. Metals, as well as some volatile and semi-volatile petroleum compounds were also reported above GW-1 standards. The installation of a landfill cap will reduce leachate generation and thereby contribute to the remediation of groundwater downgradient from the landfill. The following groundwater specific remediation technologies were also evaluated as potential components of the overall site remedy.

Slurry Wall Barriers

Slurry walls are subsurface barriers that consist of vertically excavated trenches designed to impede groundwater flow and prevent contaminated groundwater migration. The trenches are filled with an engineered slurry mixture which exerts hydraulic pressure against the trench walls and acts as shoring to prevent collapse. The slurry, usually a mixture of bentonite and water, is pumped through a pipe into the trench excavation area. The constructed slurry walls provide a barrier with low permeability and good chemical resistance. Slurry wall construction has proven to be effective in controlling the horizontal migration of contaminants in groundwater and may contribute to a Permanent Solution at the Draper landfill. This approach can be implemented using standard engineering and construction techniques and methods and individuals with the appropriate expertise are available. Slurry walls were retained for further analysis.

Hydraulic Containment

Horizontal and vertical migration can be addressed through the use of extraction wells or interception trenches and drains to create hydraulic controls. Wells and trenches or drains would be installed within the area of concern and groundwater levels would be depressed to predetermined levels to create inward gradients. Hydraulic containment may contribute to a Permanent Solution at the Draper landfill. This approach can be implemented using standard engineering techniques and equipment and individuals with the appropriate expertise are available. Hydraulic containment—as an integral component of a pump and treat alternative, described below—was retained for further analysis.

Enhanced *In Situ* Bioremediation

Bioremediation methods use microbes to break down organic hazardous constituents. The breakdown products of biodegradation are dependent on the contaminants present and the environment. In an anaerobic environment, the major breakdown products are methane, ammonia, and water. Anaerobic bioremediation is effective for converting chlorinated compounds to less chlorinated breakdown products. Many non-chlorinated hydrocarbons will also degrade under anaerobic conditions, albeit more slowly than under aerobic conditions. Under aerobic conditions, organic compounds are ultimately mineralized to carbon dioxide and water. Aerobic degradation is effective for treatment of the breakdown products of anaerobic degradation of chlorinated solvents, as well as for treatment petroleum compounds. Biological treatment processes are sensitive to pH, temperature, flow conditions, and organic concentrations. Enhanced *in situ* bioremediation was not retained for consideration because although it may accelerate the biodegradation of chlorinated hydrocarbons, the groundwater data indicate this process is occurring naturally and additional efforts to enhance the process are not considered justified.

In Situ Chemical Oxidation

Chemical oxidation involves the injection of a strong chemical oxidant into groundwater to oxidize organic contaminants. Typical chemical oxidants include hydrogen peroxide, ozone, and potassium permanganate. The efficacy of chemical oxidation depends on soil permeability at the site, the quantity of oxidant applied, and the oxidant demand exerted by the background matrix. Destruction of contaminants is generally very rapid and the reactions are exothermic. Therefore, chemical oxidation should not be used in close proximity to buildings or underground utilities. The fill materials along the southern border of the landfill contain a variety of organic material that would exert a high oxidant demand and reduce the effectiveness of the oxidation of contaminants in this area of the site. This technology was therefore not retained for consideration.

Iron Filing Reactive Wall

An iron treatment wall contains iron granules or other iron bearing materials for the treatment of chlorinated contaminants. As the iron is oxidized, a chlorine atom is removed from the compounds by one or more reductive dechlorination mechanisms, using electrons supplied by the oxidation of iron. The iron granules are dissolved in this process, but the metal disappears so slowly that the remediation barriers can be expected to remain effective for many years. This option has not been demonstrated to be effective in reducing the concentration of other site contaminants including metals or petroleum related compounds (e.g. benzene) and therefore is eliminated from further consideration.

Air Sparging

Air sparging is an *in situ* technology in which air is injected directly into the contaminated aquifer. This technology involves the controlled application of air pressure to induce bubbling within the soils residually saturated with VOCs. Injected air traverses horizontally and vertically in channels through the soil column and both dissolved contaminants and contaminants adsorbed to soils are transferred to the vapor phase. This injected air helps to flush the contaminants into the unsaturated zone where a vapor extraction system is usually implemented in conjunction with air sparking to remove the vapor phase contamination. Additionally, the introduction of oxygen into the saturated soils enhances natural aerobic biodegradation processes. This treatment option is effective in removing volatile organic contaminants from the saturated zone; although the vapors produced need to be treated before discharge to the atmosphere. This option was not retained for detailed analysis for application because it would not be effective in treating all of the contaminants present in source area groundwater (metals).

Pump and Treat

Pump and treat can use a single extraction well, a network of extraction wells, or subsurface drains oriented perpendicular to the direction of groundwater flow to withdraw groundwater for above-ground treatment. The treatment technology depends on the type of contaminants presents. Air stripping is commonly used for removing VOCs from groundwater. Treated groundwater is discharged in an appropriate manner, and oftentimes requires a local, state or federal permit. Implementation of this alternative may be effective in reducing VOC concentrations in groundwater at the southern edge of the landfill. Individuals with the appropriate expertise to implement pump and treat technologies are available. Therefore, this technology has been retained for further consideration.

Monitored Natural Attenuation

Monitored natural attenuation (MNA) involves reliance on natural attenuation processes to achieve site-specific clean-up goals. These natural processes include physical, chemical, or biological processes that, under favorable conditions and without human intervention, act to reduce mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. MNA does not necessarily preclude the use of an active remedy or remedies. Both source control and sound performance monitoring are integral components to MNA. Along with source control/containment of the landfill waste material, monitored natural attenuation was retained as a potential component for further evaluation.

3.3.3 Surface Water

Stormwater drainage from Freedom Street flows under the landfill via a 36-inch diameter culvert which discharges to the stream on the west side of the landfill. This culvert provides a direct contaminant migration pathway from the landfill to this surface water body. Remedial technologies identified as reasonably likely to be feasible to address this migration pathway include isolation of the stormwater drainage from the landfill waste material by:

1. Relocation of the drain outside of the landfill limits; and

2. Lining of the existing culvert to prevent contact with the landfill contamination.

Storm Drain Relocation

Storm drain relocation would include installation of a new drainage pipe to carry stormwater drainage from the Freedom Street area north of the landfill to a suitable discharge location. The existing culvert located under the landfill would be blocked to prevent discharge of stormwater and groundwater to the head of the stream on the west side of the landfill. The existing culvert would likely be filled with an inert material such as concrete flowable fill. The objective of this alternative is to prevent the contamination of stormwater by leachate and contaminated groundwater as it flows beneath the landfill . The relocated stormwater drain pipe will be connected to existing stormwater drainage features outside of the landfill area. Stormwater would ultimately discharge to a surface water body at a downgradient location. The work would be coordinated with the Town of Hopedale and all required federal, state and local permits and approvals would be obtained. This alternative would contribute to a Permanent Solution by eliminating this existing contaminant migration pathway which is negatively impacting the stream on the west side of the landfill. Individuals with the appropriate expertise to implement this alternative are available. The storm drain relocation is retained for detailed evaluation.

Storm Drain Isolation

Storm drain isolation would include lining and/or repair the existing culvert under the landfill from to prevent infiltration of leachate and contaminated groundwater. The objective of this alternative is to eliminate the culvert as a migration pathway for leachate and contaminated groundwater present within the landfill waste. The work would require a temporary diversion of the stormwater flow through the pipe, inspection of the pipe interior by video camera, and cleaning and repair as necessary to facilitate proper lining of the pipe. Several methods are available for eliminating groundwater infiltration, including grouting damaged pipe locations; installing a smaller diameter within the existing pipe and grouting the void space between the two pipes; and slip lining to create a new pipe interior surface. The relined/repaired culvert would continue to carry stormwater drainage from the Freedom Street area to the head of the stream on the west side of the landfill without impacts from the landfill. This alternative would contribute to a Permanent Solution by eliminating this existing contaminant migration pathway which is negatively impacting the stream on the west side of the landfill. Individuals with the appropriate expertise to implement this alternative are available. Storm drain lining/repair is retained for detailed evaluation.

3.4 Remedial Action Alternatives Retained Following Initial Screening

The remedial action alternatives retained following the initial screening are listed in **Table 3-6**. The detailed evaluation of remedial action alternatives retained from the initial screening is provided in Section 4.

Table 3-6
Remedial Technologies Retained for Detailed Evaluation

Media of Concern	***Remedial Technologies Retained for Detailed Evaluation***
Landfill Waste Material	1. Capping
Groundwater	1. Slurry wall 2. Pump and treat 3. Monitored Natural Attenuation
Surface Water	1. Storm drain relocation 2. Storm drain isolation

Section 4
Detailed Evaluation of Remedial Action Alternatives

4.1 Evaluation Process and Criteria

This section presents a detailed evaluation of the remedial action alternatives that were retained from the alternative screening process. The detailed evaluation of the alternatives includes the following steps:

- Further define each alternative with respect to the design details of the remedial action alternative, the technologies to be used, site-specific application of the technologies, and any performance requirements associated with those technologies; and

- Assess the alternative against the evaluation criteria specified in the MCP at 310 CMR 40.0858, as defined below.

The remedial action alternative evaluated to address contaminants in the landfill waste material is capping. As noted in Section 3, containment of the landfill waste materials by construction of a low-permeability cap will also mitigate contaminant migration to groundwater, surface, and sediments by minimizing leachate generation. A cap will also control landfill gas emissions. The detailed evaluation of groundwater remedial action alternatives includes slurry wall construction; enhanced *in situ* bioremediation, groundwater pump and treat, and monitored natural attenuation. Detailed evaluation of surface water remedial alternatives focus on relocation and isolation options for the stormwater culvert located beneath the landfill.

4.1.1 Evaluation Criteria

The MCP describes eight criteria to be used to evaluate each remedial action alternative:

1. Effectiveness – the ability of the alternative to achieve a permanent or temporary solution under 310 CMR 40.1000; reusing or treating oil and hazardous material at the site, and reducing contaminant concentrations that achieve or approach background;

2. Reliability – the degree of certainty that the alternative will be successful in the short- and long-term and the effectiveness of any measures required to manage residues or remaining wastes or control discharges to the environment;

3. Implementability – the comparative difficulty associated with implementing the alternative in terms of technical complexity, any necessary monitoring, operations, maintenance or site access requirements, availability of necessary

materials, equipment and services or off-site treatment/disposal facilities, and the regulatory requirements for the approval of the alternative;

4. Costs – the comparative costs of the alternatives, including design, construction, site preparation, labor, permits, operation, maintenance and monitoring costs required to implement the alternative, the costs of environmental restoration or potential damages to natural resources, and the relative consumption of energy resources during operation;

5. Risks –the short-term on-site and off-site risks associated with implementation of the alternative, including excavation, transport, containment, construction, operation and maintenance activities, the on-site and off-site risks posed over the period of time required for the alternative to attain applicable remedial standards, and the long-term risks from residual contamination left at the site following completion of the remedial action;

6. Benefits – the comparative benefits of the alternative, including those from restoration of natural resources, provision of the productive reuse of the site, avoidance of lost value of the site, and avoidance of costs of relocating people, business, or provision of alternative water supplies.

7. Timeliness – the comparative timeliness of the alternative in terms of eliminating any uncontrolled sources of oil and/or hazardous materials and achieving a level of No Significant Risk; and

8. Non-pecuniary interests – the relative effect of the alternative on interests such as aesthetic values.

The basis for each of the cost estimates presented in this section is provided in **Appendix A**.

4.1.2 Regulatory Considerations

4.1.2.1 Activity and Use Limitation

Based on the results of the Phase II CSA risk assessment, a condition of No Significant Risk does not exist at the site for unrestricted use. As such, an AUL is proposed to restrict site use and exposure scenarios and to notify future property owners about the contaminants at the site.

The MCP includes the following statements about AULs:

- 310 CMR 40.1012(1) – The purpose of an Activity and Use Limitation is to narrow the scope of exposure assumptions used to characterize risks to human health from a release pursuant to 310 CMR 40.0900 by specifying activities and uses that are prohibited and allowed at the site in the future.

- 310 CMR 40.1070(2) – Activity and Use Limitations imposed pursuant to 310 CMR 40.1012 shall be implemented and adhered to by the owner and holders of interest(s) in the property and/or a license to use the property subject to the Activity and Use Limitation, and/or the responsible person, potentially responsible person or other person conducting response actions at the disposal site or portion of a disposal site in accordance with the procedures established in 310 CMR 40.1070 through 310 CMR 40.1099.

- 310 CMR 40.1070(3) – An Activity and Use Limitation shall be deemed implemented and shall be in effect upon its being duly recorded and/or registered with the appropriate registry of deeds and/or land registration office.

- Other provisions in the MCP (310 CMR 40.1074) also indicate that the AUL shall contain information such as descriptions of site activities and uses that are permitted on the site as well as site uses that are inconsistent with maintaining a condition of No Significant Risk. A Licensed Site Professionals (LSP) opinion is required for the AUL filing and for any subsequent changes to the site activity and uses. The LSP is a hazardous waste site cleanup professional, established by the Massachusetts General Law, licensed to provide oversight of response actions at disposal sites.

The AUL for the site will list the activities and uses that are permitted and those that are inconsistent with the Response Action Outcome (RAO) for the site. The AUL will also include the requirements specified in the MCP at 310 CMR 40.1074 and 40.1075. Conceptually, the site activities and uses that would likely be consistent with the AUL include:

- Paved parking with landscaped areas for passive recreation;

- Routine non-intrusive maintenance activities of paved and landscaped areas; and

- Utility and construction work, provided that workers engaged in subsurface activities in the source areas work in accordance with a health and safety plan and a soil and waste residual management plan prepared under the direction of an LSP.

Site activities that would be inconsistent with the AUL for this site include:

- Unregulated intrusive activities such as excavation in the landfill area;
- Drinking water supply well installation; and
- Residential development.

4.2 Detailed Evaluation of Alternatives

This subsection includes the detailed evaluation of alternatives developed for the media of concern at this site.

4.2.1 Landfill Waste Material

The detailed evaluation of remedial action alternatives for the landfill waste material focuses solely on containment by construction of a landfill cap. Capping is considered the only feasible remedy because of the large volume of waste material and the heterogeneity of the oil and hazardous material present in the landfill.

4.2.1.1 Alternative 1: Capping

Description

The estimated area of waste disposal is approximately eight acres and the estimated depth of waste ranges from 10 to 30 feet below the ground surface (bgs). Using an estimated average waste depth of 20 feet over the entire eight acres of landfill results in an approximate total volume of waste material of 226,000 cubic yards.

The Phase I test pit investigation of the landfill cover material indicated the waste material is currently covered by a nonuniform layer of soil described as a sandy silt with some clay ranging in thickness from several inches to two feet. The area is covered with vegetation including grasses, brush and small trees.

The cap proposed for the Draper Landfill would be in compliance with the Massachusetts Solid Waste regulations at 310 CMR 19.000. The primary purpose of the landfill cap is to minimize percolation of water through the landfill waste and thus minimize leachate generation and subsequent impacts to groundwater, surface water and sediments. The landfill cap also serves the following functions:

- Prevent direct contact with potentially contaminated material;
- Control landfill gas emissions;
- Prevent erosion or run-off that could result in potential mobilization and migration of contaminants; and
- Include a defining layer, namely, the HDPE liner, which visually identifies the boundary between the barrier layers and the contaminated material.

This alternative involves design and construction of a low permeability cap in accordance with MA Solid Waste regulations. The approximate extent of this cap area is eight acres and is shown in **Figure 4-1**. However, the actual limits of cap installation would be confirmed in the field following confirmation of the limits of waste disposal during predesign activities.

Construction of low permeability cap would include site preparation activities to clear and grade the site followed by installation of the following cap component layers (bottom to top):

- Passive gas collection and venting layer (e.g. 6-inch layer of sand with a permeability of >$1x10^{-3}$) to allow for a controlled release of landfill gases to the atmosphere;
- Low permeability layer (e.g. 40-mil textured HDPE liner);

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PHASE III REMEDIAL ACTION PLAN

APPROXIMATE LANDFILL CAP AREA PLAN

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- Drainage layer (e.g. 12-inch sand layer with a permeability of $1x10^{-3)}$; and
- Vegetated support/protection layer (e.g. 12 layer of topsoil seeded with grass).

This alternative would involve consolidation of any exposed waste and contaminated material on the west side of the landfill under the cap as well as access controls such as fencing and signage.

This alternative would also involve implementing an AUL and a long term program to monitor site-wide groundwater. Implementation of an AUL is discussed in Section 4.1.2.1. Implementation of groundwater monitoring at the site would involve long-term monitoring. The proposed groundwater monitoring network is shown in **Figure 4-2** and summarized in **Table 4-1**.

Long-term monitoring is described in more detail below, as well as the sampling protocol to be used and the analytical parameters to be measured.

Table 4-1

Proposed Network for Site-Wide Groundwater Monitoring

Well Location	*Well Designation*
Upgradient	CDM-MW1 CDM-MW9 CDM-BR1
Crossgradient	CDM-MW2 CDM-MW8 CDM-BR2A B6-MW
Immediately downgradient	B3-MW B5-MW CDM-MW3 CDM-MW7 CDM-BR3 CDM-MW14
Further downgradient	CDM-MW4 CDM-MW5 CDM-MW6 CDM-MW15 CDM-BR4/MW18
Edge of Ballfield	B4-MW CDM-MW16 CDM-MW17

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PHASE III REMEDIAL ACTION PLAN

MONITORING WELL LOCATION PLAN

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Long-Term Monitoring
The goal of the proposed long-term monitoring program is to check groundwater quality at regular intervals to confirm the effectiveness of the cap installation in reducing groundwater contamination levels over an extended period of time. The proposed monitoring program includes five years of semi-annual monitoring at all 21 monitoring wells listed in Table 4-1. Monitoring for this initial five year period would commence following the completion of the cap installation. Groundwater monitoring requirements would be reevaluated following this initial five year period and the sampling frequency would likely be reduced. For cost estimating purposes, it is anticipated that groundwater monitoring would be reduced to annual sampling at 10 selected wells. Any modifications to the groundwater monitoring program would require the approval of the MassDEP.

Sample Collection and Analytical Parameters
During long-term monitoring, water levels will be collected from each well in the monitoring well network to evaluate hydraulic head fluctuations of groundwater at the site. Water level measurements will be taken using down-hole gauges equipped with a digital readout or cable with graduated markings. Sampling will be conducted using Low Flow Groundwater purging and sampling procedures. The static depth to water and depth to the well bottom will be recorded prior to sampling. An adjustable rate, submersible pump will be used to purge the wells and collect the samples. Conductivity, pH, temperature, dissolved oxygen (DO), and oxidation-reduction potential (ORP) will be measured and recorded. Samples for laboratory analyses will be collected after parameter stabilization and will be preserved in the field prior to delivery to the laboratory.

Groundwater sample analyses would include the following methods:

- Volatile Organic Compounds (EPA 8260B)
- Semivolatile Organic Compounds (EPA 8270C)
- PCBs (EPA 8082)
- MCP 14 Metals and iron (ICP-AES/CVAA)
- Cyanide (EPA 335.2/SM)

The method detection limits will meet applicable regulatory standards for groundwater contaminants under the MCP regulations. The analytical methods and detection limits will be employed in accordance with EPA-approved and MassDEP-approved methods. The selected sampling parameters are based on the historic groundwater data collected by CDM as part of the Phase I/Phase II investigations.

Effectiveness

Achieving a Permanent or Temporary Solution
Capping would reduce site risks by containing the source of the contamination and controlling the primary contaminant migration pathways. Capping would contribute to the achievement of a permanent solution at the site. Groundwater monitoring would allow for confirmation of the effectiveness of the cap. An AUL would eliminate

risks associated with potential contact with contaminated waste materials and exposure to contaminated groundwater.

Achieving Concentrations At or Close to Background Levels
Cap installation would help reduce contaminant concentrations in the groundwater, surface water and sediments close to background levels by reducing leachate generation.

Reliability

Short- and Long-Term Success
A landfill cap that is periodically inspected and maintained would be successful in the short- and long-term by preventing direct contact with contaminated material, minimizing the potential for vapor and dust release from contaminated materials, and preventing erosion or run-off that could potentially mobilize contaminants. Low permeability caps provide reliable long term protection against infiltration of precipitation and thereby minimize leachate generation. Instituting site restrictions via an AUL would provide the necessary controls for potential exposure pathways for contaminated media. Therefore, there is a high degree of certainty that the alternative would be successful in both the short- and long-term.

Management of Residues and Remaining Wastes
The landfill waste would remain in place and the cap would require scheduled maintenance such as mowing to protect the underlying low permeability layer and maintain its effectiveness in preventing infiltration of precipitation.

Implementability

This alternative is based on well-established technologies that are typically implemented on a regular basis during closure of solid waste landfills. Operations and maintenance requirements for the cap itself would be minimal and would consist of periodic inspection and maintenance of the integrity of the vegetative cover. The services, including engineering, labor and equipment needed for implementation of this alternative are readily available. Installation of a low-permeability cap is the standard remedy for closure of municipal solid waste landfill in Massachusetts. The cap will be constructed in accordance with Massachusetts Solid Waste regulations.

Costs

The estimated cost for this alternative is $1,902,000, including the cost of implementing an AUL and a long-term, site-wide groundwater monitoring program. These costs are itemized in **Table 4-2**.

Table 4-2
Planning-Level Cost Estimate for Alternative 1: Capping

Item/Description	Total Cost
Capital Costs	
Allowance for AUL	$25,000
Capping Costs	
Capping Materials and Installation	$1,130,000
Subtotal	$1,155,000
General Conditions, Overhead and Profit (15%)	$173,250
Contingency (25%)	$288,750
Total	$1,617,000
Annual Operation and Maintenance Costs	
Capping	
Inspection and Maintenance as Needed	$1,000/yr. × 10 yrs.= $10,000
Groundwater Monitoring	
Initial Monitoring Period (2 rounds/year at 21 wells for years 1-5)	$40,000/yr. × 5 yrs.=$200,000
Long-Term Monitoring (10 wells annually years 6 through 10)	$15,000/yr. × 5 yrs.= $75,000
Capital Cost	$1,617,000
O&M Costs*	$285,000
Total Cost	**$1,902,000**

* For planning purposes operation and maintenance cost was calculated for a ten year period.

Risks

On-site Risks

Construction of the landfill cap would involve earthwork primarily on the landfill surface only, therefore short-term risks associated with workers in contact with contamination would be minimal. Short-term risks are anticipated to be limited and would be managed by the use of appropriate health and safety measures. Compliance with the AUL would effectively mitigate long-term on-site risks from residual contamination left at the site.

Off-site Risks

Off-site risks associated with increased truck traffic transporting cap materials to the site for this alternative would be minor and will be addressed in the contract specifications.

Benefits

Capping of the landfill would allow for potential development of this area for community uses such as passive recreation. Capping will mitigate impacts to the adjacent stream and improve stream water quality.

Timeliness

The cap construction and implementation of an AUL could be completed in one construction season. Long-term monitoring is anticipated to extend a minimum of 10 years following the completion of landfill closure, and may extend up to 30 years.

Non-pecuniary Interests

This alternative would improve the aesthetics of the area. Landscaping of the completed cap area, covering of exposed waste material and improvement of the water quality of the adjacent stream would increase the aesthetic value of the area.

4.2.2 Groundwater

The following remedial action alternatives are being evaluated in detail for remediation of site groundwater:

1. Slurry wall
2. Pump and treat
3. Monitored natural attenuation

4.2.2.1 Alternative 1: Slurry Wall

Description

Under this alternative, contaminated groundwater flow from the southern edge of the landfill would be contained by a subsurface soil-bentonite slurry wall designed to restrict groundwater flow. The proposed slurry wall along the southern border of the landfill would be three feet wide, approximately 300 feet long and approximately 55 feet deep on average to key into bedrock. The proposed location is shown on **Figure 4-3.**

Components of the construction would include pre-trenching to confirm the proposed location is downgradient of the landfill waste material, importing clay fill for the backfill mix, installing the slurry wall, disposing of the excavated soil, and regrading the work area and trench spoils upon completion of the wall construction.

Following installation of the slurry wall, the groundwater monitoring program described in the capping alternative would be initiated. This alternative would be implemented in addition to the capping alternative which is necessary to control the source of contamination at the site.

Effectiveness

Achieving a Permanent or Temporary Solution

This alternative would likely reduce the mobility of contaminants in groundwater by providing subsurface containment of contaminated groundwater at the southern edge of landfill. It would help achieve a permanent solution in containing the landfill related contamination within the boundary of the landfill.

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PHASE III REMEDIAL ACTION PLAN

SLURRY WALL LOCATION PLAN

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Reusing, recycling, destroying or treating oil and hazardous materials
This alternative would not reduce oil or hazardous material concentration by recycling or treatment.

Achieving Concentrations At or Close to Background Levels
This alternative would help reduce groundwater contaminant concentrations to levels that are at or close to background outside of the landfill area.

Reliability

Short- and Long-Term Success
There is a high degree of probability that this alternative could achieve both short- and long-term success with respect to reducing the migration of landfill related groundwater contaminants and therefore reduce the risks of off-site drinking water exposure. A specialty slurry wall contractor would perform the work and standard construction QA/QC techniques would be implemented to reduce the risk of improper wall construction. Since the slurry wall is proposed on the downgradient side of the landfill, some bypass of contaminated groundwater around the wall may be possible.

Management of Residues and Remaining Wastes
Residues, including surplus excavated contaminated soil/fill material (approximately 2,000 cubic yards) would be generated during implementation of this alternative and would likely be managed by consolidation under the landfill cap. Wastes within the landfill area would also remain following implementation of the slurry wall.

Implementability

Soil-bentonite slurry wall construction would be performed by a specialty slurry wall contractor who has experience with similar jobs, making implementation of this alternative technically feasible. However, the estimated depth to bedrock of 55 feet below the ground surface along the southern edge of the landfill will require a significant effort to complete this deep excavation. Construction of the slurry wall to this depth will be moderately difficult. The materials required for the wall including an off-site clay source, powdered bentonite and a potable water source for preparation of the slurry mix are available. Monitoring requirements would be moderate, whereas operation and maintenance required would be minimal.

Costs

The estimated cost for the slurry wall alternative is $756,000. The costs are itemized in **Table 4-3** and include costs associated with construction of the slurry wall as well as long-term monitoring costs.

Table 4-3
Planning-Level Cost Estimate for Groundwater Alternative 1: Slurry Wall

Item/Description	Total Cost
Capital Costs	
Site Preparation	$150,000
Slurry Wall Construction	$270,000
Labor, Equipment and Miscellaneous Work	$120,000
Subtotal	$540,000
General Conditions, Overhead & Profit (15%)	$81,000
Contingency (25%)	$135,000
Total Cost	$756,000

Risks

On-site Risks

Short-term, on-site risks associated with implementing this alternative could be managed with appropriate health and safety measures during installation of the slurry wall. The significant depth of the slurry wall will increase the schedule and level of effort required to complete the work and associated construction health and safety risks. This alternative would reduce contaminated groundwater migration and thereby reduce potential long-term on-site risks associated with exposure to groundwater contamination. The potential for exposure to contaminated groundwater on-site is, however, considered minimal.

Off-site Risks

This alternative could possibly reduce long-term off-site risks from groundwater contamination, although these risks are already considered to be minimal.

Benefits

The implementation of a slurry wall would likely reduce the time required for groundwater downgradient from the landfill to achieve GW-1 standards.

Timeliness

Construction of the slurry wall is estimated to take approximately four to six months from mobilization to demobilization.

Aesthetics

The slurry wall will be constructed below the ground surface and will not have a negative long term impact on aesthetics. The initial construction effort would have a short-term negative impact on the work area.

4.2.2.2 Alternative 2: Pump and Treat

Description

This alternative involves extracting contaminated groundwater from the southern edge of the landfill, treating it on-site and discharging the treated water to the stream on the west side of the landfill. The groundwater treatment system proposed includes air stripping with air emissions treatment via activated carbon.

To implement this alternative, eight extraction wells would be placed along the downgradient edge of the landfill, as shown in **Figure 4-4**. It is assumed that the pumping rate would be 50 gpm (= 144,000 gpd), as estimated from expected groundwater flow to the downgradient edge of the landfill. It is further assumed that pumping and treatment would be implemented for a period of 10 years.

Effectiveness

Achieving a Permanent or Temporary Solution
Pump and treat is expected to reduce contaminant concentrations in groundwater and provide hydraulic containment of contaminated groundwater. Both of these outcomes of pump and treat would help achieve a permanent solution at the site.

Reusing, recycling, destroying or treating oil and hazardous materials
This alternative would reduce groundwater contaminant concentrations by treatment. Treatment options would likely include air stripping and carbon filters.

Achieving Concentrations At or Close to Background Levels
This alternative would help reduce groundwater contaminant concentrations to levels at or close to background levels outside of the landfill area.

Reliability

Short- and Long-Term Reliability
This alternative could help achieve success with respect to reducing contaminant concentrations in groundwater. However, a groundwater pump and treat system, implemented without containment of the source of the contamination by capping, would likely not be successful in reducing contaminant levels below GW-1 standards in the short term. The potential for long term success would be greater but the time required to achieve the GW-1 clean-up standards would likely be significant.

Management of Residues and Remaining Wastes
Residues would include the spent carbon from the air stripping treatment unit. Vapor discharge from the air stripping tower would be treated with granular activated carbon (GAC). Spent GAC would be disposed of in accordance with applicable EPA and MassDEP standards. Installation of the groundwater extraction wells would generate waste soil cuttings and well purge water, which would require disposal within the landfill or at approved off-site disposal facilities.

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PHASE III REMEDIAL ACTION PLAN

GROUNDWATER PUMP AND TREAT LOCATION PLAN

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Implementability

This alternative is based on a proven technically feasible approach, which has been successfully implemented at other disposal sites. It would require intrusive work to install extraction wells as well as system piping, which could be performed without much disruption to the surrounding area. Monitoring, operation, and maintenance requirements would be substantial: monitoring would be required during the duration of pumping periodic monitoring, as would operation and maintenance activities. The services and materials needed for pump and treat are readily available. Discharge of the treated groundwater to the adjacent stream would require a permit from appropriate regulatory authorities.

Costs

The estimated cost for the pump and treat alternative is $560,000. The costs are itemized in **Table 4-4** and include costs for groundwater extraction and treatment.

Table 4-4

Planning-Level Cost Estimate for Groundwater Alternative 2: Pump and Treat

Item/Description	Total Cost
Capital Costs	
Groundwater Extraction System	$132,000
Groundwater Treatment System	$41,000
Health and Safety	$5,000
Labor, Equipment and Miscellaneous Work	$15,000
Subtotal	$193,000
General Conditions, Overhead & Profit (15%)	$29,000
Contingency (25%)	$48,000
Subtotal	$270,000
Annual Operation and Maintenance Costs	
General System Maintenance	$1,000
Compliance Sampling, Analyses and Reporting	$18,000
Power	$10,000
Subtotal	$29,000
Capital Costs	$270,000
Operation and Maintenance*	$290,000
Total Cost	$560,000

* For planning purposes operation and maintenance cost was calculated for a 10 year period.

Risks

On-site Risks

Short-term, on-site risks associated with implementing this alternative could be managed with appropriate health and safety measures (air monitoring, soil management) during installation of extraction wells, system piping, and the treatment system. The alternative would likely reduce long-term on-site risks from groundwater contamination.

Off-site Risks
This alternative could possibly reduce long-term off-site risks from groundwater contamination, although these risks are already considered to be minimal.

Benefits

The implementation of pump and treat would reduce the time required for cleanup of site groundwater to GW-1 standards.

Timeliness

The pump and treat alternative would be require long-term operation to achieve clean-up objectives.

Non-pecuniary interests

A pump and treat system would require installation of pumping and treatment equipment, utilities, and appurtenant structures which would negatively impact site aesthetics. The system would increase the noise level at the site.

4.2.2.3 Alternative 3: Monitored Natural Attenuation

Description

This alternative involves monitoring of natural degradation of groundwater contamination levels over an extended period of time by scheduled sampling and analyses of the monitoring well network. Contaminant degradation processes were discussed in the Phase II CSA and include dilution; volatilization, biodegradation; adsorption and chemical reactions. The groundwater monitoring completed to-date indicates natural attenuation processes currently result in landfill related contamination decreasing to levels below GW-1 standards within approximately 400 feet downgradient of the southern edge of the landfill.

Effectiveness

Achieving a Permanent or Temporary Solution
Monitored natural attenuation in addition to containment of the landfill waste by cap construction will contribute to a permanent solution by reducing groundwater concentrations below GW-1 standards and thereby help achieve a level of no significant risk at the site.

Reusing, recycling, destroying or treating oil and hazardous materials
This alternative would reduce groundwater contaminant concentrations by natural physical, chemical and biological processes.

Achieving Concentrations At or Close to Background Levels

This alternative would help reduce groundwater contaminant concentrations to levels at or close to background outside of the landfill area.

Reliability

Short- and Long-Term Success

There is reasonably high degree of certainty that this alternative (along with cap installation) would achieve reductions in VOC concentrations in the long term. The chlorinated hydrocarbons detected in site groundwater include TCE and its breakdown products 1, 2 –DCE and VC, indicating that biodegradation is occurring at the site. In addition, the groundwater data clearly indicate the highest concentrations of VOCs in monitoring wells located at the landfill southern boundary with concentration decreasing with distance downgradient from the landfill, further indicating concentration reductions associated with natural attenuation processes.

Management of Residues and Remaining Wastes

There would be no residues from this alternative.

Implementability

Monitored natural attenuation is simple to implement at the Draper Landfill site. Monitoring of the process would include groundwater sampling of existing monitoring wells to evaluate the effectiveness of the process.

Costs

The costs for this alternative are low and include groundwater sampling and analytical costs.

The estimated cost for the monitored natural attenuation alternative is $300,000. The costs are itemized in **Table 4-5**.

Table 4-5
Cost Estimate for Groundwater Alternative 3: Monitored Natural Attenuation

Item/Description	*Total Cost*
Capital Costs	
Allowance for AUL	$25,000
Annual Operation and Maintenance Costs	
Monitoring	
Initial Monitoring Period (2 rounds/year at 21 wells for years 1-5)	$200,000
Long-Term Monitoring (10 wells annually years 6 through 10)	$75,000
Capital Cost	$25,000
Operation and Maintenance Costs*	$275,000
Total Cost	$300,000

*For planning purposes operation and maintenance cost was calculated for a ten year period.

Risks

On-site Risks

The health and safety risks associated with this alternative are considered to be minimal. Groundwater monitoring activities would be conducted under a health and safety plan to address any potential risks.

Off-site Risks

This alternative would reduce long-term off-site risks from groundwater contamination, although these risks are already considered to be minimal.

Benefits

Benefits of this alternative include the negligible impacts to the site. The monitoring activities can be scheduled to avoid conflict with activities in the ballfield area downgradient of the landfill.

Timeliness

This alternative will likely take an extended period of time to achieve compliance with MCP GW-1standards. It is estimated that natural attenuation processes may reduce landfill related groundwater contaminant levels below GW-1 standards within 10 years of completing landfill capping.

Aesthetics

This alternative will not affect site aesthetics. Groundwater monitoring activities for each event are anticipated to be completed within three days. The alternative will use existing site monitoring wells to obtain groundwater samples to monitor the attenuation process.

4.2.3 Surface Water

The following alternatives are being evaluated in detail for remediation of surface water:

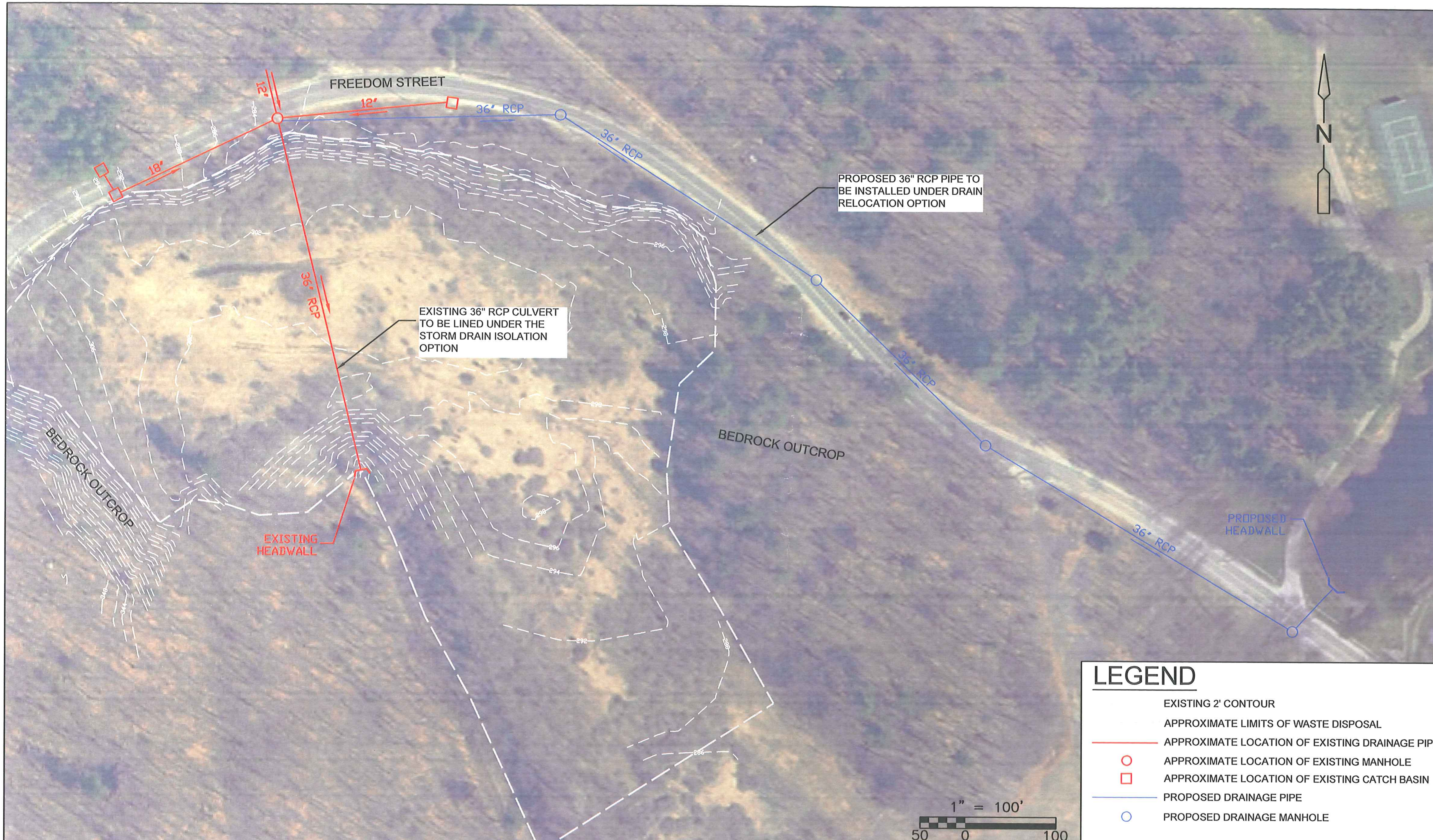
1. Culvert relocation
2. Culvert isolation

The current location of the storm drain culvert beneath the landfill as well as the proposed relocation of the storm drain are shown on **Figure 4-5**.

4.2.3.1 Alternative 1: Culvert Relocation

Description

Under this alternative, stormwater flow from the Freedom Street area north of the landfill would be redirected into a new storm drain around the landfill. The existing culvert would be blocked and filled to prevent this drain line from providing a



CDM Camp Dresser & McKee Inc.

DRAPER LANDFILL, HOPEDALE, MA

PHASE III REMEDIAL ACTION PLAN

STORM DRAIN CULVERT RELOCATION / ISOLATION PLAN

DATE	SHEET NO.	LOCATION	ADDENDUM NO.	FIGURE NO.
02/04/09				4-5

migration pathway for leachate contaminated groundwater to discharge to the stream on the west side of the landfill.

Effectiveness

Achieving a Permanent or Temporary Solution
This alternative would help achieve a permanent solution by removing the stormwater drainage flow beneath the landfill as a contaminant migration pathway to surface water and sediments on the west side of the landfill.

Reusing, recycling, destroying or treating oil and hazardous materials
This alternative would not reduce oil or hazardous material concentrations by recycling or treatment, but would eliminate this existing pathway for contaminant discharge to the stream on the west side of the landfill.

Achieving Concentrations at or Close to Background Levels
This alternative would help reduce surface water and sediment contaminant concentrations to levels at or close to background outside of the landfill area.

Reliability

Short- and Long-Term Success
There is a high degree of certainty that this alternative could achieve both short- and long-term success with respect to reducing the migration of landfill related contaminants and therefore reduce the risks from potential exposure to contaminated surface water and sediment. Installation of a new storm drain outside of the landfill limits could be performed by standard construction techniques and the new pipe route would provide a reliable means for stormwater flow to an appropriate discharge location. Blocking and filling the existing culvert with concrete or similar inert material would prevent the potential future releases of contaminated groundwater. A contractor would perform the work and standard construction QA/QC techniques would be implemented to confirm proper construction.

Management of Residues and Remaining Wastes
Surplus excavated material would be generated during installation of the stormwater drain line around the landfill and would likely be managed by disposal or reuse as clean fill. Wastes within the landfill area would also remain following implementation of this alternative.

Implementability

Stormwater drain line construction would be performed by a contractor who has experience with similar drain line installation projects, making implementation of this alternative technically feasible. The labor, equipment and pipe materials required for this alternative are readily available.

Costs

The estimated cost for the pipe relocation alternative is $630,000. The costs are itemized in **Table 4-6** and include costs associated with construction of a new stormdrain line and blockage of the existing 36-inch culvert under the landfill.

Table 4-6
Cost Estimate for Surface Water Alternative 1: Culvert Relocation

Item/Description	Total Cost
Capital Cost	
36" RCP Installation	$360,000
Pre-cast Manhole Installation	$20,000
Headwall Installation	$15,000
Bedrock Excavation	$30,000
Decommission/ Block Old Culvert	$5,000
Resident Engineer Oversight	$20,000
Subtotal	$450,000
General Conditions, Overhead, Profit (15%)	$67,500
Contingency (25%)	$112,500
Total	$630,000

Risks

On-site Risks

Short-term, on-site risks associated with implementing this alternative would be minimal since the majority of the work would be outside the landfill limits and could be managed with appropriate construction health and safety measures.

Off-site Risks

This alternative would reduce long-term off-site risks from the contaminated stormwater flow to surface water and sediment on the west side of the landfill.

Benefits

Relocation of the drain line around the landfill and blockage of the existing culvert would eliminate the migration of contaminants via stormwater flow under the landfill. This alternative would thereby reduce the time required for surface water and sediment on the west side of the landfill to achieve cleanup standards.

Timeliness

Relocation of the existing storm drain is estimated to take approximately two months from mobilization to demobilization.

Aesthetics

The storm drain relocation will be constructed below the ground surface and will not have a negative impact on aesthetics.

4.2.3.2 Alternative 1: Culvert Lining/Repair

Description

Under this alternative, the 36-inch concrete culvert under the landfill would be inspected and repaired/relined to prevent this drain line from providing a migration pathway for leachate contaminated groundwater to discharge to the stream on the west side of the landfill. This alternative would likely require cleaning of the existing culvert to facilitate inspection and repair/relining.

Effectiveness

Achieving a Permanent or Temporary Solution
This alternative would help achieve a permanent solution by removing the stormwater drainage flow beneath the landfill as a contaminant migration pathway to surface water and sediments on the west side of the landfill. Relining/repair of the culvert would prevent infiltration/inflow of leachate and contaminated groundwater into the culvert.

Reusing, recycling, destroying or treating oil and hazardous materials
This alternative would not reduce oil or hazardous material concentrations by recycling or treatment, but would reduce the release of contamination into the culvert.

Achieving Concentrations at or Close to Background Levels
This alternative would help reduce surface water and sediment contaminant concentrations to levels that are at or close to background outside of the landfill area.

Reliability

Short- and Long-Term Success
There is a high degree of certainty that this alternative could achieve both short- and long-term success with respect to reducing the migration of landfill related contaminants and therefore reduce the risks from potential exposure to contaminated surface water and sediment. Video inspection, cleaning, repair and relining to prevent infiltration and inflow into the existing culvert can be effectively performed by a number of available specialty contractors. A contractor would perform the work with engineering oversight and standard construction QA/QC techniques would be implemented to confirm proper construction.

Management of Residues and Remaining Wastes
Cleaning of the culvert is required prior to repair and relining and this process will generate solid and liquid waste materials. This material will require characterization and proper disposal either in the landfill or at an approved off-site disposal facility. Wastes within the landfill area would also remain following implementation of this alternative.

Implementability

Culvert repair and relining would be performed by a contractor who has experience with similar jobs, making implementation of this alternative technically feasible.

There are several pipe repair/relining methods, including grouting and slip lining, that are readily available to effectively isolate the culvert and prevent infiltration/inflow of contaminated groundwater. The results of the video inspection of the culvert will help determine the most appropriate method for implementation.

Costs

The estimated cost for the pipe lining/repair alternative is $160,000. The costs are itemized in **Table 4-7** and include costs associated with cleaning, video inspection, waste disposal, and culvert repair and relining by slip lining.

Table 4-7
Cost Estimate for Surface Water Alternative 2:
Culvert Lining/Repair

Item/Description	Total Cost
Capital Cost	
Initial TV Inspection	$3,000
Heavy Pipe Cleaning	$18,000
Pipe Lining	$80,000
Post Lining TV Inspection	$3,000
Resident Engineer Oversight	$10,000
Subtotal	$114,000
General Conditions, Overhead, Profit (15%)	$17,100
Contingency (25%)	$28,500
Total	$160,000

Risks

On-site Risks

Short-term, on-site risks associated with implementing this alternative would be minimal and primarily associated with management and disposal of waste materials removed from the culvert. These short term risks could be managed with appropriate construction health and safety measures.

Off-site Risks

This alternative would reduce long-term off-site risks from the contaminated stormwater flow to surface water and sediment on the west side of the landfill.

Benefits

Repair and relining of the culvert beneath the landfill would eliminate the migration of contaminants via stormwater flow under the landfill and thereby reduce the time required for surface water and sediment on the west side of the landfill to achieve cleanup standards.

Timeliness

Repair and relining of the existing storm drain culvert is estimated to take approximately two months from mobilization to demobilization.

Aesthetics

The storm drain lining/repair will be constructed below the ground surface and will not have a negative impact on aesthetics. The result will be an improvement in the water quality of the stream on the west side of the landfill.

Section 5
Selection of Remedial Action Alternative

5.1 Introduction

Selection of a Remedial Action Alternative is discussed at 310 CMR 40.0859 of the MCP. This section of the MCP specifies that remedial action alternatives shall be selected based on the detailed evaluation criteria including effectiveness, reliability, implementability, cost, risks, benefits, timeliness, and aesthetics. The remedial action alternative selected shall be a permanent solution if a feasible permanent solution has been identified and its implementation is more cost-effective and timely than would be for the implementation of a temporary solution. Remedial actions implemented to achieve a permanent solution should be designed, to the extent feasible, to reduce the concentrations of oil and hazardous material in the environment to levels that achieve or approach background.

This section of the MCP also notes that a cap or other remedial action alternative that relies upon on-site disposal, isolation, or containment of the contaminated material shall not be selected until a Phase III evaluation demonstrates the lack of a feasible alternative. Capping was selected to control the source of contamination at the Draper landfill based on the results of the detailed evaluation of remedial action alternatives provided in Section 4. Capping was considered the only feasible remedial action alternative based primarily on the large volume and heterogeneity of the contaminated waste material present in the landfill. The overall site remedy also includes remedial action alternative components for groundwater and surface water.

5.2 Selected Remedial Action Alternative

5.2.1 Description

The selected remedial action alternative for the Draper Landfill includes the following components:

- Capping the landfill area and long-term groundwater monitoring (Landfill Waste Material Alternative 1);
- Monitored Natural Attenuation (Groundwater Alternative 3);
- Culvert Relining/Repair (Surface water Alternative 2).

The implementation of this combination of remedial action alternatives would involve design and construction of a low permeability cap over approximately eight acres of the landfill waste material in accordance with Massachusetts Solid Waste regulations, as well as the implementation of a long-term groundwater monitoring program. Monitored natural attenuation is proposed for remediation of site groundwater and repair/lining of approximately 400 linear feet of 36-inch diameter concrete drain pipe under the landfill is proposed for remediation of surface water. This remedial approach would also require implementation of an Activity and Use Limitation

(AUL) to control potential exposure to contamination associated with the buried waste material and contaminated groundwater.

The site investigations conducted to-date by CDM have focused on the Draper Landfill located on the northern portion of the property. The Phase III selected remedy addresses contamination associated with the landfill waste material. As previously noted in the Phase II CSA, the 2006 EPA Non-Superfund Targeted Brownfields Assessment Final Report included a Method 3 risk characterization for the ballfield area of the property. This risk characterization concluded that no significant human health risk existed for exposure to surface soil under the current site use. CDM anticipates that an AUL to restrict potential future exposure to subsurface soils in the ballfield area, similar to that proposed for the landfill, would be required for closure under the MCP for the entire site.

5.2.2 Rationale for Selection

Capping of the landfill waste material is the selected remedy for remediation of the landfill waste material because it provides an effective and reliable means of containing the waste related contamination. Capping is the accepted standard for mitigation of landfill waste related contamination because it cost-effectively controls contaminant exposure routes, including direct contact with waste; landfill gas; erosion by wind and stormwater runoff and groundwater, surface water and sediment contamination by leachate generation.

Capping is EPA's "presumptive remedy" for municipal landfill sites because it effectively addresses both the large volume and heterogeneous nature of the waste in a cost effective manner. Capping will mitigate the generation of contaminated leachate and thereby contribute to the improvement of groundwater quality by minimizing the source of contamination. Controlling the generation of leachate will also serve to improve surface water and sediment quality on the west side of the landfill where impacts from leachate seeps were observed. Potential construction-related exposure to landfill waste will be addressed by the implementation of an appropriate health and safety plan in accordance with contract specifications.

Chlorinated hydrocarbons were consistently reported in a number of monitoring wells immediately downgradient from the southern edge of the landfill. Exceedences of GW-1 standards at these wells contributed to a finding of Categorical Significant Risk because of the site's location in a Zone II area. Three groundwater remediation alternatives, including slurry wall construction, groundwater pump and treat and monitored natural attenuation, were evaluated in Section 4. Although, implementation of the slurry wall would likely improve groundwater conditions by controlling groundwater flow to the south, the relative complexity and high costs associated with construction of the wall do not justify the benefits. Similarly, the pump and treat alternative would reduce groundwater contaminant concentrations immediately downgradient from the landfill; however the installation, operation and maintenance costs would be significant, contaminant concentrations currently decrease within a short distance downgradient and conditions are anticipated to improve following the installation of a landfill cap.

The monitored natural attenuation alternative was selected as the groundwater remedy because groundwater investigations indicate that natural attenuation is already occurring, and therefore, this remedy provides a more cost effective remedy for the conditions currently present at the site. Although the site is located in a Zone II area, the groundwater data indicates that the primary contaminants specifically related to the landfill (i.e. TCE, 1, 2-DCE, and VC) decrease in concentration to below the GW-1 standards within a relatively short distance downgradient from the landfill. While exceedances of the GW-1 standards (generally within the same order of magnitude) are consistently reported at monitoring wells near the southern edge of the landfill; the frequency of detection and concentrations decrease approximately 400 feet downgradient in the next series of monitoring wells. In the last series of monitoring wells located approximately 400 feet further downgradient; no chlorinated hydrocarbons were detected above method detection limits. Although GW-1 exceedences were also reported for some metals, including arsenic, vanadium, antimony, and barium at downgradient monitoring wells, the pattern of detection does not indicate the landfill as the likely source and these detections are more likely associated with the fill materials present in the ballfield area. Given that the area downgradient from the landfill is provided with a public water supply and there are no private water supply wells reported in this area, the risks to human health under current conditions are minimal.

Waste disposal at the landfill ceased approximately 30 years ago and therefore conditions within the landfill have substantially stabilized to some extent. The presence of the breakdown products VC and 1, 2-DCE indicates that degradation of TCE is occurring at the site. The decrease in the frequency of detection as well as the concentration of landfill related contamination indicates natural attenuation processes at the site. Given the minimal groundwater related site risks, the evidence of ongoing natural attenuation processes and the cost advantages, monitored natural attenuation in conjunction with landfill capping is the recommended remedial alternative for groundwater remediation.

Further, the implementation of site-wide groundwater monitoring as part of the capping alternative will allow on-going assessment of the nature and extent of groundwater contamination and monitoring of natural attenuation on site.

Repair and/or lining of the 36-inch diameter culvert running underneath the landfill to isolate stormwater in the culvert from contact landfill related contamination are the recommended remedial alternative for surface water. Isolating the culvert will remove this contamination migration pathway for landfill leachate to the stormwater drainage and thereby improve water quality in the stream on the west side of the landfill. Isolating the culvert was selected over relocation of the storm drain based primarily on the greater implementability (less difficult installation and no additional permitting requirements) and lower costs for this alternative.

These selected remedial action alternative components, along with their estimated costs, are summarized in **Table 5-1**.

Table 5-1

Summary of Selected Remedial Action Alternatives and Costs

Alternative No.	***Description***	***Cost***
Landfill Waste Material Alternative 1	Landfill Cap (with AUL and long-term monitoring)	$1,902,000
Groundwater Alternative 3	Monitored Natural Attenuation (MNA)	$275,000
Surface Water Alternative 2	Culvert Repair/Relining	$160,000
Total (The landfill cap cost includes the monitoring costs associated with MNA)		**$2,062,000**

5.3 Feasibility Evaluations

310 CMR 40.0860 of the MCP requires that the Phase III RAP include the following feasibility evaluations:

1. feasibility of implementing a Permanent Solution;
2. feasibility of reducing concentrations of oil and hazardous material in the environment to levels that achieve or approach background;
3. feasibility of reducing concentrations of oil and hazardous material in soil to levels at or below applicable soil Upper Concentration Limits (UCLs); and
4. feasibility of eliminating, preventing or mitigating Critical Exposure Pathways.

5.3.1 Feasibility of Implementing a Permanent Solution

The MCP defines a Permanent Solution as a "measure or combination of measures which will, when implemented, ensure attainment of a level of control of each identified substance of concern at a disposal site or in the surrounding environment such that no substance of concern will present a significant risk of damage to health, safety, public welfare, or the environment during any foreseeable period of time."

The proposed remedial approach for the Draper Landfill will contribute to the achievement of a Permanent Solution. Installation of a landfill cap will effectively contain waste related contamination and control potential contaminant releases associated with direct contact, leachate generation, landfill gas emissions, erosion, and contaminated groundwater. Capping the landfill will improve groundwater, surface water and sediment quality by controlling the source of the contamination, thereby allowing natural attenuation processes to reduce contaminant concentration below GW-1 standards. The low-permeability cap placed over the landfill waste material will provide and effective and well-defined barrier between the clean surface materials and underlying contaminated materials. Risks associated with potential exposure to waste contamination by intrusive activities within the landfill boundaries would be eliminated by the implementation of an AUL. Repairing and relining the culvert under the landfill would eliminate this contaminant migration pathway for the forseeable future.

5.3.2 Feasibility of Reducing Concentrations to Levels that Achieve or Approach Background

The MCP requires that, if a Permanent Solution is selected, the feasibility of reducing the concentration of oil and hazardous material to levels that achieve or approach background must be evaluated.

MassDEP guidance developed in July 2004[1] specified both categorical and site-specific criteria for evaluating the feasibility of achieving or approaching background. The conditions at the Draper Landfill site do not meet the criteria for categorical feasibility (*i.e.*, the cost of conducting a remedial action would be small and exceeded by the benefit or risk reduction). MassDEP considers that remediation to background conditions of contamination limited to 20 cubic yards or less of soil contaminated solely by petroleum products is categorically feasible. Nor do the conditions at the Draper Landfill meet any of the criteria for categorical infeasibility (*i.e.*, the cost of conducting a remedial action would be substantial and almost always disproportionate to the incremental benefit or risk reduction). These categorical infeasibility cases include excavations under permanent structures, remedial actions that will substantially interrupt public service or threaten public safety, remediation of degradable contaminants, and remediation of persistent contaminants located in areas with lower exposure potential. The MCP requires a site-specific feasibility evaluation be performed which considers both the technical feasibility and the relative benefits and costs associated with achieving or approaching background concentrations. Background concentrations are generally defined by the MCP as those levels of oil and hazardous materials that would exist in the absence of the disposal site of concern. Given the volume of waste material and associated contamination associated with the Draper Landfill (and landfills in general), achievement of background levels would require the completed removal and off-site disposal of the estimated 226,000 cubic yards of waste material as well as a large volume of impacted soil below the waste material. Although excavation and offsite disposal is technologically feasible; the time, effort, adverse construction related impacts and exorbitant price make the costs obviously substantial and disproportionate to the incremental benefits.

5.3.3 Feasibility of Reducing Contaminant Concentrations in Soil to Levels at or Below UCLs

The MCP requires that, if a Permanent Solution is selected, the feasibility of reducing the concentration of oil and hazardous material in soils below soil UCLs must be

[1] DEP Policy #WSC-04-160. Conducting Feasibility Evaluations Under the MCP. July 2004.

evaluated. The soils investigation at the Draper landfill site focused on the physical characteristics of the existing cover soils within the limits of waste disposal; test pit observation and soil sampling to define the limit of waste disposal; and subsurface soil sampling at soil boring locations for monitoring well installations. Characterization of the landfill soil and waste material by sampling and analyses was not performed because the presumed remedy of containment does not require this information. Although there may be concentrations of hazardous material or petroleum above UCLs in the landfill, none were identified in the investigations conducted to-date at the site.

5.3.4 Feasibility of Eliminating, Preventing or Mitigating Critical Exposure Pathways

Critical Exposure Pathways are defined by the MCP (at 310 CMR 40.0006) as those routes by which oil and/or hazardous material released at a disposal site are transported to human receptors by:

(1) vapor phase emissions into the living or working spaces of a pre-school, daycare, school or occupied residential dwelling; or

(2) ingestion, dermal absorption or inhalation from drinking water supply wells located at and servicing a pre-school, daycare, school or occupied residential dwelling.

The Phase II CSA confirmed that there are no Critical Exposure Pathways associated with the Draper landfill. There are no pre-schools, daycares, schools or occupied residential dwellings subject to vapor phase emissions or serviced by drinking water supply wells impacted by the Draper Landfill. The residential area downgradient from the landfill is serviced by a public water supply and the nearest occupied residential dwelling is located over 500 feet from the landfill.

5.4 Schedule for Implementation of Phase IV Activities

CDM anticipates that a Phase IV Remedy Implementation Plan (RIP), including the preliminary design of the cap for the Draper Landfill and isolation of the landfill stormwater culvert would occur in 2009 with construction activities to follow in 2010.

Appendix A
Cost Estimating Calculations (Planning Level)

Table 1
Preliminary Estimate of Landfill Cap Costs
December 2008

Item #	Item Description	Subtitle D Cap Unit Cost	Per	Quantity	Item Subtotal
1	Site Preparation/Mobilization	$9,800.00	acre	8 acres	$ 78,000
2	Erosion Control Barriers	$9.00	LF	2,000 feet	$ 18,000
3	Gas Venting Layer - 6 inches thick	$5.00	SY	20,000 sq yds	$ 100,000
4	Gas Venting Layer - 12 inches thick	$10.25	SY	– sq yds	$ -
5	Low Permeable Soil Capping Layer (Region I) - 12" Thick	$13.75	SY	– sq yds	$ -
6	Clay Capping Layer (Subtitle C) - 24" Thick	$32.00	SY	– sq yds	$ -
7	HDPE Membrane - 20 mil.	$4.00	SY	– sq yds	$ -
8	HDPE Membrane - 40 mil.	$9.75	SY	20,000 sq yds	$ 195,000
9	HDPE Membrane - 60 mil.	$7.25	SY	sq yds	$ -
10	Sand Drainage Layer - 12 inches thick	$10.00	SY	20,000 sq yds	$ 200,000
11	Drainage Geo-Composite	$6.75	SY	– sq yds	$ -
12	Filter Fabric	$1.50	SY	– sq yds	$ -
13	Topsoil and Seeding/Maintenance - 8" Thick	$8.25	SY	– sq yds	$ -
14	Topsoil and Seeding/Maintenance - 12" Thick	$12.50	SY	20,000 sq yds	$ 250,000
15	Topsoil and Seeding/Maintenance - 24" Thick	$25.00	SY	– sq yds	$ -
16	Perimeter Rip-Rap	$28.50	SY	1,000 sq yds	$ 29,000
17	Erosion Control Blanket	$2.00	SY	20,000 sq yds	$ 40,000
18	Vegetated Drainage Swale	$45.75	LF	2,500 sq yds	$ 114,000
19	Rip-Rap Downshoots	$28.50	SY	100 sq yds	$ 3,000
20	Sedementation Basin	$57,000.00	LS	1 each	$ 57,000
21	Hazardous Waste Drum Allowance	$342,000.00	LS	- each	$ -
22	Stormwater Control System Allowance	$57,000.00	LS	- each	$ -
23	Miscellaneous Work and Cleanup	$5,985.00	acre	8 acres	$ 48,000
24	Roadways	$30.00	SY	- sq yds	$ -
25	Fencing	$45.00	–	- feet	$ -
26	Drainage Piping	$8.75	LF	0 feet	$ -
27	Waste Relocation	$18.00	SY	0 sq yds	$ -
28	Wetland Restoration	$32.00	SY	0 sq yds	$ -
	Subtotal Cap Closure				**$1,132,000**
	Price of Cap per Acre ($/acre)				**$141,500**

CDM

Pump and Treat

Item Description	Unit	Qt	Unit Price	Cost	
INSTALLATION OF UNDERGROUND PIPING					
Oversight	ea	1	$1,800	$1,800	
Utility Trench	lf	200	$36	$7,100	
Gravel Backfrill	ton	15	$23	$346	
4" PVC Discharge Pipe	lf	100	$15	$1,500	
Copper Trace Wire	lf	100	$1	$50	
Treatment System Enclosure	ls	1	$15,000	$15,000	
Equipment Pad	sf	120	$10	$1,236	
Cast in Place Footing	lf	50	$25	$1,250	
Concrete Block Access Manholes	ea	8	$4,000	$32,000	
Subtotal				$60,282	
WELL INSTALLATION					
Mob/demob	ea	1	$550	$550	
oversight	ea	1	$1,800	$1,800	
4" Extraction wells	lf	450	$64	$28,800	
Wellhead makeup	ea	8	$178	$1,424	
Submersible pump	ea	8	$4,970	$39,760	
Subtotal				$72,334	$132,616
UTILITY INSTALLATION					
Utility Installation	ls	1	$4,800	$4,800	
Circuit Breaker	ls	1	$8,900	$8,900	
Subtotal				$13,700	
SYSTEM INSTALLATION					
Mob/demob	ea	1	$4,300	$4,300	
Air Stripper w/ controls	ea	1	$16,000	$16,000	
Carbon Off-gas Treattment	ea	1	$8,000	$8,000	
Subtotal				$28,300	$42,000
EQUIPMENT					
Backhoe	weeks	2	$4,700	$9,400	
Laborers	days	10	$568	$5,680	
Subtotal				$15,080	
Total				$189,696	
General Conditions, Overhead, Profit (15%)				$28,454	
Contingency (25%)				$47,424.05	
TOTAL				$265,575	

Slurry Wall Cost Estimate
Wall dimensions = 300' x 3' x 55'

Item Description	Unit	Qt	Unit Price	Cost	
GENERAL CONDITIONS					
Mob Demob	ea	1	$150,000	$150,000	
Survey	ls	1	$10,000	$10,000	
Health and Safety Equipment	ls	1	$50,000	$50,000	
Subtotal				$210,000	$210,000
SITE PREPERATION					
Work area prep and material laydown	acre	1	$10,000	$10,000	
Pre Trenching 3' x 300' x 8'	cy	265	$25	$6,625	
Water Man.	ls	1	$20,000	$20,000	
Erosion Control	lf	500	$2	$1,000	
Clearing and Grubbing	acre	1	$2,500	$2,500	
Analytical Testing	ls	1	$20,000	$20,000	
Subtotal				$60,125	$60,000
WALL CONSTRUCTION					
Work Platform Construction	cy	350	$20	$7,000	
Import clay fill	cy	1800	$15	$27,000	
Installation of wall	vsf	16500	$12	$198,000	
Installation of clay top (2' high by 5' wide)	cy	112	$15	$1,680	
Regrade work platformand clay top	cy	462	$5	$2,310	
QC Testing	ls	1	$12,500	$12,500	
Residual Materials Handeling	cy	2000	$10	$20,000	
Subtotal				$268,490	$270,000
ADDITIONAL COSTS					
Subtotal				$538,615	$540,000
Overhead and Profit (15%)				$80,792	$81,000
Contingency (25%)				$134,654	$135,000
TOTAL				$754,061	$756,000